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ASTRONOMY AND RELIGION.

BY SIR EDWIN ARNOLD, K. C. I. E., C. S. I.

GREAT results often spring from very small causes. In the ancient town of Middelburg, in Holland, on a clear autumn day in the year of grace 1606, an old optician named Jan Lippershey had a little job in hand, which was to repair the spectacles of a worthy Mynheer, member of the City Council. He had laid the thick circular glasses to be reset on his work-table, in front of a large old-fashioned mullioned window that looked over the roofs of a flat country in the midst of which rose a church-spire with a clock. The church was about half a league distant and the figures of the clock were small and in the crabbed Gothic character. By the old craftsman's side played his grandchild, who had taken up the lenses and was applying them in an idle mood this way and that to his eye. Suddenly the child uttered a Dutch exclamation of delight and cried, "O grandfather, I can see the hour!" And in effect he had by accident so adjusted the two glasses that a telescopic result was produced; and Jan Lippershey, repeating the experiment, read with facility the time from that casement, holding the glasses in the same manner.

From such a chance moment dated the invention of the telescope; and from that same moment also, a new era of scientific knowledge dawned, which must result, though it has not yet resulted, in a new era of religious thought.

Galileo heard of what the optician's little grandson had found out, and in the year 1609 he constructed the first telescope. It was not much more powerful than the opera-glass which the pilot or the racing-man now employs; but by its aid the illustrious astronomer was the first to view the spots on the sun; to see four moons revolving around Jupiter; to descry mountains and plains in the moon; to watch the phases of Venus; and to distinguish many stars which had been invisible before. Those earliest observations revolutionized all astral science. Ptolemy and the ancients silently and suddenly abdicated in favor of Copernicus, Galileo himself, and Tycho Brahe. There was come to an end forever that old conceited ignorance which pictured our planet as the centre of the universe, with the moon and stars for night-lights, and the sun the brilliant but humble attendant of the earth. Little as this immense advance in knowledge has been yet realized by the common imagination, the Church of Rome had an instinct of the revolution; but neither her then mighty power, nor any other influence, could prevent a sudden and swift transformation in human ideas. The least informed mind cannot well take itself back now to the time when a Hebrew writer really believed and recorded that at the command of Joshua the moon stood still in the valley of Ajalon, while another inspired scribe could chronicle it as a serious fact that the sun had gone back on its course to prolong the life of King Hezekiah. Galileo, upon whom the prodigious new veracities instantly and imperatively flashed, was compelled by the priests verbally to recant his splendid declarations. But rising from his knees he muttered the famous reservation "*E pur se muove*"; and for all ages to come there was thus created out of that accidental deed of the little Dutch boy at play, a new heaven and a new earth for mankind.

Galileo in his "Sidereal Messenger" made a map of eighty new stars which he had discovered in the constellations of Orion's Belt and the "Sword"; and since then astronomer after astronomer, as is well known, has added various groups and galaxies to the two or three thousand conspicuous stars of the first six magnitudes which can be always seen with the naked eye. It is curious and not complimentary to the good sense of mankind that those stars should have been looked upon as merely intended to spangle the sky and give light at night. As lamps they were always a failure. Sixty times the total starlight on the clearest night would not equal the illumination given by the moon; and thirty-three million times their radiance would be required to equal sunlight. Yet the stars which are seen even by a powerful telescope are now known to be only an insignificant proportion of those actually existing inside "visible space." Telescopic photography, as practised to-day in all the observatories, reveals, in almost every apparently blank region of the celestial sphere, countless new and distant worlds, lying far beyond all methods of mortal computation and measurement. The only foot-rule with which we can at all estimate the scale of distances in the "visible universe" is light. This travels along the ether at the rate of 186,000 miles in a second, so that the ray which we receive from the sun left his surface eight minutes before it has reached our eyes. By ingenious processes based on complex arithmetic, astronomers have determined the distance of about eighty stars, and the nearest of all of them to our system is *Alpha Centauri.* The radiance of this star takes, however, about four years to reach human vision, while that which we perceive from *Alpha Tauri* or *Aldebaran* was projected from its glittering source twenty-seven years ago; and most of those seen deeper in the night sky are so far off that their present light left them three or four hundred years back. Many are to-day visible whose beams have travelled to our gaze only after a lapse of thousands of years, and there must be radiant streams now on their way from heavenly bodies in the empyrean which will only reach the eyes of our very far off posterity.

To what comparative insignificance do these well-known and well-assured facts reduce the little corner of space in which our own trivial family of planets has its being and its motion! It seems much to say that the earth is distant from the sun ninety-three millions of miles, so that to travel thither at the average rate of a tourist by steam and rail would take an interval of 600 years. And the outside planet of our family, *Neptune,* is two thousand eight hundred and twenty-five millions of miles from the sun, so that we may roughly call the diameter of our flying system in space five thousand six hundred and fifty millions of miles. But vast as this sounds, our solar system sinks into a speck when one reflects that if we should represent the interval between the sun and the earth by one inch, then to put *Aldebaran* into his proper place and proportion our chart would have to be nine leagues wide. At this moment the great work is everywhere advancing of making a photographic picture of the entire visible heavens; all stars down to the fourteenth magnitude are being reproduced. Twenty-two thousand separate plates will complete the planisphere, and it is estimated already that as many as twenty million distinct stars will appear upon the unparalleled and astonishing map.

It is vain to endeavor to reduce into intelligible or adequate language the vastness of material creation revealed in such a chart; a vastness augmented by the measureless variety of the bodies and systems included in the immense conspectus. Gazing near at hand there are indeed all sorts of absorbing wonders on and around the sun himself; a world of marvels exists in those "rice-grains" upon his surface which look like specks and are all larger than Great Britain, in the "willow leaves," the "granules," the "faculæ," "the spots"; in those scarlet flags of flame called "prominences"; and in the "corona"—which at the time of a solar eclipse are seen stretching for millions of miles outside the orb. Those early theologians who taught that the sun was made to warm and illuminate this our poor little planetary island did not know that only one part in two thousand two hundred millions of his heat and light are received by the earth. The rest, in the boundless prodigality of nature, goes away into space to do, no doubt, much subtle work. And then, besides the sun, there are tantalizing mysteries in

"That orbed maiden
With white fire laden
Whom mortals call the moon."

One side of her we have never beheld, but that which is always turned towards her elder sister is painted in silvers and grays with a landscape of acclivities and levels which nobody really understands. Astronomers say too rashly that there can be no life on the moon because there is no atmosphere there and no moisture. Dead silence must reign over Moonland, they aver, since there is no air to vibrate; barrenness must prevail, since there falls no rain; and the heat of the sun must alternately scorch it, and then be withdrawn, producing a cold greater than any which Professor Dewar can create. Then there are the planets of which we know just a little, as people often do of their own particular families: Mercury and Venus inside our own orbit; Mars outside it; and, beyond him, stately Jupiter, Saturn with his Ring, Uranus, and Neptune. Comparatively near as these are, and presenting well-marked features to the glass, they are yet so far divided and so minute compared to the space they swim in that if the earth were represented by a football at Hyde Park Corner, Neptune would be such a four-foot globe as an acrobat walks upon, placed at Oxford. Between Mars and Jupiter swarm in the ether those silver bees of the system called asteroids: perhaps the fragments of an exploded planet, the baby children of our system, already 370 in number and increasing with yearly observations. The largest of them, *Vesta,* is but 300 miles in diameter. Beyond Jupiter again, circle those large mysterious planets about which astronomers again foolishly say that they must be lifeless, failing to perceive that life equates itself to its conditions, and that just as lungs are the correlation and the consequence of an atmosphere of oxygen and nitrogen, and gills the adaptation to water as a medium of existence, so there may be creatures on the sun which thrive upon incandescent hydrogen ; Moon-people who flourish without air or water; Jovians and Saturnians, well contented with an abode in a state of vapor ; and Uranians, with a scheme of body and being unimagined, but suitable to their environments and real as a railway director. Then beyond these, our close neighbors, are the comets, the stars, the nebulæ, the "Milky Way,"—that "river of light and life" which, searched by the glass, presents itself as a fathomless channel of sweeping stars. Inconceivably distant from him, man has yet means to-day which bring these within the range of his knowledge. The spectroscope, aided by photography, tells us the substance and the chemistry of these remote worlds. Doctor Huggins has found hydrogen in the "nebulæ," and Secchi in certain stars also, while the rate at which they approach or recede can be accurately measured. Thus *Aldebaran* is going away from us at thirty miles a second, and *Gamma Leonis* approaching us at a slightly lower speed. The great telescope of the Lick Observatory, which I myself had the privilege one night of using, has settled the fact that the Nebula of Orion is flying from us at ten miles a second. We know, in fact, enough of this marvellous "visible universe" to be proud and glad of our increasing knowledge, but never to presume upon it as final or sufficient.

Indeed, our best acquaintance with its wonders must always be held provisional. The organ wherewith we are aware of it is an imperfect one, insensible to the colors beyond the red and the violet which certain insects appear to perceive. Light itself is nothing but a vibration of what we call, without understanding it, the ether; and sight is a sense easily deceived and of very feeble range. It is probable that only a slight exaltation of the power of the optic nerve would present the picture of the starry sky to us in a very different aspect. To our vision the waste of space appears astounding, much as the Pacific Ocean seems far too large for its archipelagoes. The boundless vault looks as though wasted in containing at such enormous intervals the tiny specks that are its worlds and suns. Would it wear anything like so open an aspect if we had better or different eyes? To see the stars at all it is necessary to wait for the darkness of night: to be aware of those crimson fountains of glory streaming into space from the sun, we have to borrow the help of the moon's interposed disc. Since all heavenly bodies exercise an influence, gravitatory and otherwise, upon all other bodies, it is conceivable that a kind of vision may hereafter exist to which their mutual contact and interaction would be perceptible. We see nothing now which is not of the nature to reflect upon our retinas or to project upon them those light-waves of which alone our light-sense can take any cognizance. The fish which dimly perceives a star through the water composed of oxygen and hydrogen is not in a much worse position for reliable astronomical observations than man, with his limited visual spectrum, at the bottom of his ocean of oxygen, nitrogen, and the new gas.

Astronomy has taken, however, an immense start forward in estimating the cosmos since that discovery by the little Dutch boy, which put her sisters, Philosophy and Religion, quite out of step. The spell of habit binds, however, even astronomers themselves. Not only do they use contentedly the phrases consecrated by ancient ignorance such as "sun-rise" and "sun-set," spoken foolishly of an orb which, as far as we are concerned, neither rises nor sets; but most of them cannot shake themselves free from absolutely primitive ideas about life. You shall read them gravely declaring the uninhabitability of the sun, the moon, and the planets, as before remarked, because of physical differences forsooth between those bodies and our earth. They go on contentedly with the old stellar chartography which Ptolemy introduced when he divided the stars into forty-eight constellations, giving to each of them the name of a character in Classic Mythology. Modern astronomers, unwilling or unable to improve upon this, have added about twenty more pagan names to those of Ptolemy; and even when fantastic figures are not delineated round the groups of stars, the ancient appellations are still retained. No doubt there is a convenience in this, as it helps the "star-gazer" to map out his sky; and a good observer will know the "Lyre," the "Swan," the "Plough," and "Cassiopeia" as well as any teacher of geography the outlines of various states and countries. But no attempt has been made to break away into a new and more adequate astrography, based as it might be on the marvellous symmetries and geometrical collocations of the sky. This subject of astral perspective has indeed engaged singularly little scientific attention. The study which should excite and delight most of all the scientific imagination is content to view its universe as an indefinitely or infinitely expanding hollow sphere, the boundaries of which perpetually recede before the increasing power of the lens or the resolute exercise of inductive reason. But if our experimentalists suspended in a vast glass globe endless numbers of electric lamps of different sizes, and surveyed the illumination from a point inside or outside, how long would it be before chance furnished us with such a shapely arrangement as those of the three jewels in the Belt of Orion; the rhomboid in Charles's Wain; or the measured localization of the stars in the Southern Cross? The best thing that could happen for mankind would be if a great astronomer had been born a poet or a great poet should become an astronomer; for we sadly need newer and nobler ideas in the chief of sciences.

But if, in view of the good and useful work which astronomers are undoubtedly doing in collecting facts and adding to the range of actual knowledge, we excuse them for not rising to the rich sublimity of the cosmic side of their business, it is not so easy to forgive modern philosophy and modern theology. Physical and metaphysical writers are equally to blame for the very slight influence which they have permitted latter-day astronomy to exercise upon their disquisitions. Yet the meaning of the word "metaphysics" would almost appear to suggest that every great enlargement of view in natural science ought to be followed by an expansion of thought in speculative philosophy. "Metaphysics" is a fine sonorous word, like "Mesopotamia," but it merely means that when Aristotle had finished writing about the objects in Creation (*Τὰ φυσικά*) he commenced quite naturally to discourse about "*μετά τὰ φυσικά*," or "the things that come next after objects of creation." Surely that is an obvious sequence, and if our metaphysicians, especially those of the pessimistic school, would saturate themselves with the new truths of astronomy, extending their mental focus to even the present range of the visible universe, we should not read dreary and dismal jeremiads about the origin and end of life, nor in the social field witness such a folly as anarchism raising its selfish and ridiculous banner under the stately march of the stars. Of all the fools' paradises ever built by man, the idlest and the meanest is that one of mere material comfort and easy subsistence without work, which seems to satisfy certain base democratic ideals. If life be what some among our demagogues teach to their stupid and passionate listeners, a threescore and ten years span, spent best if spent in meat and drink and voting, then Carlyle was justified, when gazing on the stars he cried, "Ah, sir! 'tis a sorry sight!" As I myself have written in "Lotus and Jewel":

> "Either the Universe is Chaos, Chance,
> Or else the Universe is Order, law;
> If that, die and let go the drunken dance;
> If this, live and rejoice in love and awe."

In vain has the star-bespangled Night, giver of sleep and rest, comforter of men, revealed under her dark mantle the splendid secret of worlds upon worlds and boundless being, if not even this has sufficed to silence upon the lips of bitter and disbelieving man doubt as to the ultimate rightfulness of nature, whose law of order, evolution, and harmonious issues is written in such large silver letters upon the skies. Nothing, in truth, so much exalts our sense-perception, and at the same time admonishes and humiliates it, as the manifestations of astronomy.

With the tube of the Lick telescope directed into the thickest milky effulgence of the Galaxy, the eye seems to plunge into the actual glory of infinitude and literally to see the illimitable. If there be immutable reasons why we should temporarily live in what we call the "present," amid allusions of time and space—which must be false in the sense of the Hindoo Maya, but need not be fallacious—how could there be devised a nobler consolation, a loftier promise, than in such glimpses which convince the mind of the infinity and immortality that it cannot in this life understand? On such a head there are two notable passages in the New Testament. One is where the great Teacher of Nazareth, perhaps with his divine eyes fixed at the time upon the shining firmament, said pityingly, "In my father's house are many mansions; if it were not so I would have told you." And the other passage is a saying from the same tender and holy lips—"The Kingdom of Heaven is nigh unto you, yea, even at your very gates." Probably these last words, at once so simple and so mysterious, condense a prodigious physical fact. It may well be that the next great secret of existence is hidden from us by a veil so thin that its very thinness makes it impenetrable. A touch, a turn, a change, as slight as when the light pebble lying on the thin ice feels it melt and falls to the bottom, may be all that is necessary to lift the curtain of another and utterly transformed universe which is yet not really another; but this same one that we see imperfectly with present eyes, and think timidly with present thoughts. As Browning sings of his beautiful dream which came so near to realization:

> "Only to break a door of glass,
> Only a bridge of cloud to pass,
> Only one wicked Mage to stab,
> And look you, we had kissed Queen Mab."

So it may be with many, possibly with most, at that natural promotion and permutation called death. Mathematicians talk as of something more solid than a dream in regard of what they call a Higher Space, that of Four Dimensions; and advanced photographers are hoping it may some day be feasible to take pictures with the ultra-red rays, which pass through opaque matter, and to which a brick wall is perhaps transparent. Returning, however, to what is visible and known, the infinite vitality of the universe must be borne in mind, as well as its boundless extent and variety. The late Mr. Richard A. Proctor has well written, in his *Other Worlds than Ours,* these eloquent words:

> "Instead of millions of inert masses, we see the whole heavens instinct with energy—astir with busy life. The great masses of luminous vapor, though occupying countless millions of cubic miles of space, are moved by unknown forces like clouds before the summer breeze; star-mist is condensing into clusters; star-clusters are forming into suns; streams and clusters of minor orbs are swayed by unknown attractive energies, and primary suns singly or in systems are pursuing their stately path through space, rejoicing as giants to run their course, extending on all sides the mighty arm of their attraction, gathering from ever new regions of space supplies of motive

energy, to be transformed into the various forms of force—light and heat and electricity—and distributed in lavish abundance to the worlds which circle round them."

Perhaps the most ludicrous survival of primitive human ignorance about the heavens is the doubt which orthodox astronomers still maintain upon the question whether life exists amid all these fair and wonderful mansions of life. And here, indeed, is where there seems to come in the truest and most urgent necessity that religion should extend the boundaries of her doctrines, in order to render them a little more adequate to the range of scientific acquisitions. Take, for instance, what is called the "scheme of salvation" as it is preached by ordinary interpreters. How deplorably it continues to be narrowed down into the limits of the old-fashioned notions of the "world"! Let me hasten to concede that no discovery, no generalization, no new revelation of the vastness, variety, and vital fullness of the cosmos could ever rob of its divine value the inner meanings of what is eternally true. The idea of redemption by love, for example, which has a thousand illustrations even in the little sphere of human experience, would probably only derive greater and greater magnificence of demonstration if we could see and know its operation in systems developed beyond our own; and amid that immense, and to-day inconceivable, march of evolution, of which we get only shadows here. But is it not evident that we must think more largely than to imagine ourselves, or to let those whom we teach imagine, that the Son of God was once absent from such an universe as we now perceive—from the splendid spaciousness of His dominions of light and life—wholly abstracted in the care and charge of "this little 0, the earth?" The love of God, manifested in Him, was doubtless present with us, as with all the cosmos; but to think becomingly and proportionately to facts, we must recognize that it was also and simultaneously present in every abode of planetary and stellar—perhaps of galactic and nebular—society. We meditate too meanly upon heavenly love, and divine government, and the life of man, and the lives which are to be, when our minds still thus wear the garments of old theologies, while our hands hold the telescope and the spectroscope. We have enlarged enormously our conceptions of the universe, but apparently forgotten to magnify our beliefs. A schoolgirl of to-day knows that the specks of silver in the ocean of the night are sun-worlds; but her rector or teacher reads her still the legends of Joshua and Hezekiah, and permits her to think that for thirty years long, some 1,894 years ago, a million million orbs and systems —full of living beings—were without the second Person of the Trinity, absent on urgent duty upon an atom of a world, invisible to the very nearest of them.

It is charming to observe with what simplicity the delicate and gentle genius of Mr. Ruskin, in his *Frondes Agrestes*, has grappled with this incompatibility between old tenets and modern discoveries. He begins by deploring how little men care to know or think about the sky "in which Nature has done more for the sake of pleasing man—more for the sole and evident purpose of talking with him and teaching him—than in any other of her works." "And yet," writes Mr. Ruskin (Section 3, p. 35):

> "We never attend to it, we never make it a subject of thought, except as it has to do with our animal sensations; we look upon all by which it speaks to us more clearly than to brutes, upon all which bears witness to the intentions of the Supreme, that we are to receive more from the covering vault than the light and the dew which we share with the weed and the worm, only as a succession of meaningless and monotonous accident, too common and too vain to be worthy of a moment of watchfulness or a glance of admiration."

Again, speaking of the infinitude of things to know, and of the much that never can be known, revealed in the starry firmament, he says:

> "None but proud or weak men would mourn over this, for we may always know more, if we choose, by working on; but the pleasure is, I think, to humble people, in knowing that the journey is endless, the treasure inexhaustible—watching the cloud still march before them with its summitless pillar, and being sure that, to the end of time, and to the length of eternity, the mysteries of its infinity will still open farther and farther, their dimness being the sign and necessary adjunct of their inexhaustibleness."

But, brought face to face with the largeness of the cosmos and the littleness—at least as relates to verbal definition—of the pre-Galileo religions, Mr. Ruskin takes refuge in the provisional and, so to speak, personal character of the orthodox doctrines and the "scheme." "We must not," he argues,

> "define and explain ourselves into dim and distant suspicion of an inactive God inhabiting inconceivable places, and fading into the multitudinous formalisms of the laws of Nature. All errors of this kind arise from the originally mistaken idea that man can, 'by searching, find out God—find out the Almighty to perfection'—whereas it is clearly necessary, from the beginning

to the end of time, that God's way of revealing himself to his creatures should be a *simple* way, which *all* those creatures may understand. Whether taught or untaught, whether of mean capacity or enlarged, it is necessary that communion with their Creator should be possible to all; and the admission to such communion must be rested, not on their having a knowledge of astronomy, but on their having a human soul. In order to render this communion possible, the Deity has stooped from his throne, and has not only in person of the Son, taken upon him the veil of our human *flesh*, but, in the person of the Father, taken upon him the veil of our human *thoughts*, and permitted us, by his own spoken authority, to conceive him simply and clearly as a loving father and friend; a being to be walked with and reasoned with, to be moved by our entreaties, angered by our rebellion, alienated by our coldness, pleased by our love, and glorified by our labor; and, finally, to be beheld in immediate and active presence in all the powers and changes of creation. This conception of God, which is the child's, is evidently the only one which can be universal, and, therefore, the only one which *for us* can be true."

This is all true, beautiful, and to the purpose of the eminent author's thought; but it is an explanation of the survival of old religious ideas, rather than a justification of them. The astronomer and the house-cat enjoy, of course, the sunshine equally, but the former understands, as the latter does not, some at least of the wonders of that golden warmth. My representation is that the divine significations of those of the old doctrines which have eternal truth in them ought by their expounders to be henceforward immeasurably expanded and advanced, in the light of astronomical announcements. My object in these purely suggestive pages (for to exhaust the point would demand such another paper) is to indicate how new, superb, and noble are the meanings which the ancient formulas might receive from current facts, if their professional interpreters could and would rise to the heights whither "star-eyed science" to-day beckons them. "Life," "Love," "Redemption," "Creation," "Evil," "Good," and that most vast and vague name of "God" are words of might and majesty, which need to-day bolder and more hopeful re-translations into that glorious, albeit ever mystical, language of which the starry heavens display at least the silver cypher.

EDWIN ARNOLD.